12 October 2006

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THE CONTROL OF SAFETY OF RADIOACTIVE WASTE MANAGEMENT AND DECOMMISSIONING IN FRANCE

1. NATIONAL AND FRAMEWORK FOR MANAGEMENT AND REGULATION OF RADIOACTIVE WASTE AND DECOMMISSIONING

1.1 National framework

1.1.1 Overview of National policy

The French nuclear activities produce solid, liquid or gaseous waste, some of which is radioactive. The national policy on radioactive waste is that reliable, transparent and stringent management of this waste must ensure the protection of individuals, preservation of the environment and limitation of undue burdens imposed on future generations.

After their operating period, nuclear installations need to be decommissioned and dismantled in due time. Installations (NPPs, nuclear plants, research installations, etc.) have to remain at all times in a satifactory safety condition, even they have ceased to be operated, taking into account the specific nature of the dismantling operations. Dismantling operations produce radioactive waste which has to be managed with the same principle as the above-mentionned one.

In this respect two important laws were promulgated in 2006:

- the law about transparency and security in the nuclear field (13 June 2006),
- the 2006 programme act on the sustainable management of radioactive materials and wastes (28 June 2006).

Radioactive waste management :

The general principles of radioactive waste management are the following (see the above-mentioned 2006 programme act on the sustainable management of radioactive materials and wastes):

- radioactive materials and wastes of whatever nature, resulting in particular from the operation or dismantling of installations using radioactive sources or materials, shall be managed sustainably with due regard for the protection of personnal health, safety, and the environment,

- to avert or limit the burden that will be borne by future generations, research is undertaken and the necessary means for the definitive securing of radioactive wastes shall be implemented,

- producers of spent fuels and radioactive wastes are responsible for those substances, without prejudice to the responsibility their holders have as nuclear activity operators.

A National Plan for the management of radioactive waste is considered as an important tool to improve radioactive waste management. As stipulated by the above-mentionned 2006 programme act, such a plan will be issued by the end of 2006. It is supported by a National inventory of radioactive wastes and recoverable materials.

Decommissioning / dismantling :

Upon completion of their operating period, Basic Nuclear Installations (BNIs) undergo a series of decontamination and transformation operations followed by dismantling up to the defined end-state. The Nuclear Safety Authority (ASN) fosters a return to the public sector (for uses which may or may not be restricted), subject to possible adjusted encumbrances.

The scenario for each nuclear installation (immediate or deferred dismantling) is selected by the operator on a case by case basis, generally in the light of comparative studies. However, the operator is asked to justify that the strategy proposed is the best one in terms of safety and radiation protection. The operator is also asked to justify the decommissioning end state of the considered installation.

The Nuclear Safety Authority (ASN) encourages complete dismantling either immediately or after slight deferral, for various reasons. At present all operators in charge of a current dismantling operation apply this policy.

The technical provisions applicable to installations to be decommissioned must obviously be in compliance with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiation, criticality, the production of radioactive waste, release to the environment of radioactive effluents or measures designed to limit accident hazards and mitigate their consequences.

Waste originating from dismantling work is managed in the same way as waste originating from installations in operation. Although Directive 96/29/Euratom so allows, French regulations have not adopted the notion of release threshold, i.e. the generic levels of radioactivity below which the effluents and waste from nuclear activity can be disposed of without supervision. There is no release of materials from nuclear zones which are not declassified from nuclear zones to conventional zones.

International Conventions :

In order to share the experience of other countries, France signed the “Joint convention on the safety of spent fuel management and on the safety of radioactive waste management” on 29 September 1997. The joint convention was ratified on 22 February 2000.

France also signed other conventions, such as:

- the convention on early notification of a nuclear accident,

- the convention on assistance in the case of nuclear accident or radiological emergency,

- the London convention.

Scope of facilities or activities covered by the present document :

The scope of facilities or activities covered by the present document is large. It includes nuclear power plants (NPPs), nuclear fuel cycle facilities, research centers, defence activities, medical activities, industrial activities.

1.1.2 Overview of relevant institutions

Energy policy

The institutions in charge of energy policy are the Parliament, the Government and the DGEMP (General Directorate for Energy and Raw Materials) of the ministry of industry.

Regulatory framework

The law about transparency and security in the nuclear field (13 June 2006) creates a nuclear safety authority as an independent administrative body. This is being put in place and the official existence of this independent body should become effective before the end of 2006.

The acronym of the (former or new) nuclear safety authority is ASN (Autorité de Sûreté Nucléaire). In this document, the wording "new ASN" is used whereever it is necessary to distinguish it from the former one.

The status of the new ASN does not fundamentally change the missions up to now assigned to *the Direction générale de la sûreté nucléaire et de la radioprotection*" (DGSNR), and *the Divisions de sûreté nucléaire et de radioprotectio*n" (DSNR) set up within the Regional Directorates for Industry, Research and the Environment (DRIRE).

In the context of application for Basic Nuclear Installations (BNIs) authorizations, modification or final shutdown and decommissioning decrees, the Interministerial Commission for Basic Nuclear Installations (CIINB) is consulted by the ministers for environment and for industry.

Nuclear facilities which are not considered as Basic Nuclear Installations (BNIs) because they deal with a quantity of radioactive material at an activity level below the threshold of BNIs are required to comply with the environmental protection provisions specified in the Law 76-663 of 19 July 1976, insofar as they belong to the category of facilities classified on environmental protection grounds (ICPE). They are controlled at the local level by the DRIRE under the supervision of the Ministry of Environment.

Uranium mines are under the supervision of the Ministry of Industry. Disposal of mining and milling residues is classified on environmental protection grounds.

Nuclear installations connected to military activity are under the control of the *Délégué à la sûreté nucléaire et à la radioprotection pour les activités et installations concernant la défense* (DSND).

According to the 2006 programme act on the sustainable management of radioactive materials and wastes (28 June 2006), a national commission is tasked with evaluating, annually, the progress of research and studies on the management of radioactive materials and wastes with reference to the National Plan for the management of radioactive waste.

National Radioactive Waste Management Agency

A specific public agency, ANDRA, has the responsibility for the long-term management of radioactive waste. This agency operates waste repositories, defines the acceptance criteria for waste packages in these repositories and controls the quality of their production. The agency is also in charge of designing, siting, and constructing new disposal facilities. It keeps a National inventory of radioactive waste in France (existing waste and forecasts).

1.2 National, technical regulatory organization

1.2.1 Regulatory function of the ASN

The missions of the ASN essentially relate to:

- regulation
- control
- information of the public,

in the field of nuclear safety (BNIs during all their lifetime from creation to decommissioning, radioactive waste management, spent fuel management, sources, contaminated sites by radioactive material,...) and radiation protection, to protect workers, patients, the public, and environment.

A clear distinction between the respective competence of the government and the new ASN is defined by the law about transparency and security in the nuclear field. This law makes clear what decisions will be made by the government and what will be left to the new ASN. The new ASN will contribute to the preparation of regulations which will be signed by ministers. It will give its opinion and advice to the government about decrees and ministerial orders and will take regulatory decisions from a technical point of view. The new ASN will verify that operators actually follow regulations and specific requirements related to their installations or activities. It will also contribute to the information of the public, including in case of emergency situation. Besides, in case of emergency situation, it will assist the government technically.

In the framework of its regulatory functions concerning the safety of BNIs, the ASN issued basic safety rules (RFS) which constitute guidelines defining the safety objectives to be achieved and describing accepted practices deemed compatible with these objectives.

Up to now the licensing of BNIs is performed within the framework of the decree of 11 December 1963 which provides for an authorisation decree procedure followed by a series of licenses issued at key points in plant lifetime: provisional license for start-up of normal operation, final license after several years of operation, decommissioning licenses.

Before the authorisation decree is signed, the facility has to provide a safety analysis report and an environmental impact study. In case of operating licences, and, most of the time for decommissioning / dismantling of a nuclear installation, the reports are subjected to public debate in the framework of a public inquiry. A technical instruction procedure is followed implying a peer review by the competent Advisory Committee (see § 1.2.2.3). Consultations of the different ministries concerned are set up.

A decree in application of the law about transparency and security in the nuclear field will be issued in the next future. It will update, and thus replace, the above-mentioned decree of 11 December 1963

1.2.2 Organisation and resources

1.2.2.1 Organisation of the ASN

The total staff of the ASN, in September 2006, was 413 persons (including the services of regional offices of DRIRE).

The new ASN will be composed of a college of five members (including the chairman), an executive committee, a central office comprising the existing seven departments, and the services of the existing regional services. Concerning the seven centralized department, three are in charge of the different kinds of BNIs, one is in charge of radiation protection, one is in charge of organisation of control and organisation in case of emergency situations, one is in charge of pressure vessel control and one is in charge of international affairs. The control of waste packages, disposal facilities and decommissioning/dismantling is under the responsibility of the department in charge of research facilities, dismantling of nuclear facilities, contaminated sites and radioactive waste (15 persons). There are also a General secretariat (also in charge of information) and a Legal affairs and organization unit.

Since 2000, BNIs have payed an annual tax to the State and ASN has had financial resources from the national budget. The budget of the ASN for 2006 amounts to 50 M.Euros, and the ASN benefits from expertise of its technical support IRSN (see § 1.2.2.2 below) corresponding to a budget of 71 M.Euros.

1.2.2.2 Technical support of the French Nuclear Safety Authority

The main technical support organisation of the ASN is the *Institut de radioprotection et de sûreté nucléaire* (IRSN), created in February 2002. IRSN is constituted by the former Institute for Nuclear Safety and Protection (IPSN) and by part of the former Office for Radiation Protection (OPRI). It employs 1 500 persons. It is an independent public agency, separated from the CEA (French Atomic Energy Commission) in 2002. Its household takes its

source mainly from the ministry of environment but the ministries of industry, research, defense and health are also members of the administration council.

A large part of IRSN activity is devoted to R&D dedicated to safety and radiation protection. The detailed analyses of the operator's safety files are performed by the Safety Evaluation Department for nuclear plants, laboratories, shipment and waste management (DSU) which is part of IRSN. The technical support work for the ASN is performed in the framework of a convention.

1.2.2.3 Advisory Committees (experts groups)

Four Advisory Committees comprising experts and representatives of the Administration were created to assist the ASN by ministerial decisions of 27 March 1975 and 1 December 1998:

- the Advisory Committee for radioactive waste,
- the Advisory Committee for laboratories and plants
- the Advisory Committee for nuclear reactors
- the Advisory Committee for transport

The Advisory Committees are consulted on the important aspects regarding the safety of the facilities and activities within their sphere of competence.

In particular, they examine the safety analysis reports produced by the operator for each BNI during all its lifetime and also general matters (basic safety rules, consequences of new management of nuclear fuel, policy and strategy of the main producers of radioactive waste,...). They are provided with a report presenting the results of the assessment conducted by the IRSN, and issue an opinion with a number of recommendations.

2. REGULATORY ARRANGEMENTS

2.1 Primary Legislation and General Regulation

Basic Nuclear Installations and organisation of their control and information

- law 2006-686 about transparency and security in the nuclear field (13 June 2006), which:

  . stipulates the main principles to be implemented with regard to nuclear activities (this includes requirements concerning conditions and procedures for final shut-down and dismantling/decommissioning of nuclear installations);

  . creates the ASN, as an independent administrative authority (and defines its role as well as the role of government);

. organizes nuclear transparency ;

. revises the administrative framework for nuclear facilities, clarifies and reinforces the system of controls and applicable penalties.

- Decree 63-1228 of 11 December 1963. This decree concerns the definition, the licensing and control of basic nuclear installations (BNIs) including nuclear waste processing plants, interim storage facilities and nuclear waste disposal facilities such as surface disposal facilities of short lived low and intermediate level waste. It also concerns the final shutdown and decommissioning/dismantling of BNIs (authorization procedures). This decree will be updated and replaced by a future decree taking into account of the provisions laid down in law 2006-686 about transparency and security in the nuclear field (13 June 2006) and the ASN's note of 27 February 2003.

- Ministerial Order of 10 August 1984. This Ministerial Order defines the principles and rules that each operator of BNIs must follow to assure quality of design, construction, and operation of BNIs.

Installations classified on environmental protection grounds

- Code of Environment, articles L511, L512 (law 2003-699 of 30 July 2003), L513 to L516, and decrees.

- Code of Public Health, article L1333-11 and R1333-13 concerning NORM (naturally occurring radioactive material) and TENORM (technically enhanced naturally occurring radioactive material).

- Ministerial order of 25 May 2005 concerning activities handling naturally occuring radioactive materials, not used for their radioactive properties (including the list of such activities).

Installations working for Defence

- Decree 2001-592 of 5 July 2001 concerning safety and radiation protection in nuclear activities for Defence purposes (INBS).

Waste management

- Code of Environment articles L541 related to the law 75-633 of 15 July 1975, modified in 1992, concerning treatment, disposal and elimination of waste and the information of the public on environmental impact. They apply to all types of waste conventional (i.e. non-radioactive) or radioactive (excepted if other provisions are made by regulations specific to radioactive waste).

- the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006) which defines:

. the national policy for the management of radioactive materials and wastes (see details in § 3.2.1 below),

. the organization and funding of the management of radioactive materials and waste, and

. controls and sanctions.

- Ministerial Order of 31 December 1999. This Ministerial Order defines the general technical regulations for prevention and limitation of pollution and external hazards due to the operation of BNIs. It contains provisions concerning waste management (conventional waste and radioactive waste) : identification and description, by the operator, of zones producing conventional (non-radioactive) waste and zones producing radioactive waste, generalization of waste surveys in the form of documents submitted to ASN's approval, etc.

- Circular of the Ministry of Health 2001/323 of 9 July 2001. This circular asks each medical establishment (nuclear medicine) for an internal radioactive waste management plan.

- Decree of 30 May 2005 (traceability of waste).

Decommissioning

See law 2006-686 about transparency and security in the nuclear field (13 June 2006) and decree 63-1228 of 11 December 1963, as above mentioned.

Information and participation of the public, including environmental impact assessments

- Code of Environment articles L121 and R121 to R125, and decrees.

- Other regulations

- Public Health Code, Labour Code...

See also law 2006-686 about transparency and security in the nuclear field (13 June 2006).

2.2 Regulations concerning specific activities or facilities

2.2.1 Radioactive waste management

There are several decrees and ministerial orders, particularly as regards :

- The National Agency for Radioactive Waste Management (ANDRA),

- Decree for entering the surveillance phase (10 January 2003) of the Centre de la Manche facility (surface repository),

- Licensing of the Centre de l'Aube facility (surface repository for short lived low- and intermediate level waste) (Ministerial letter of 24 December 1991 and definitive operating license on 2 September 1999),

- Licencing of the very low level waste repository, also in the Aube Department (Authorization order signed by the Aube Prefect on 26 June 2003, this installation being classified on environment protection grounds ICPE),

- Decree of 3 August 1999 authorising ANDRA to create and operate, at Bure (Meuse), an underground laboratory in order to study deep geological formations for disposal of high level waste and long lived radioactive waste.

2.2.2 Decommissioning/dismantling

- There is a specific decree for each concerned BNI.

2.3 Guidance on implementation

2.3.1 Radioactive waste management

- RFS I.2 (19 June 1984): Safety objectives and design basis for surface disposal of short lived, low and intermediate level radioactive waste.

- RFS III.2.a (24 September 1982): General safety measures for production, control, treatment, conditioning and interim storage of reprocessing waste.

- RFS III.2.b (12 November 1982): Particular safety measures for production, control, treatment, conditioning and interim storage of high level waste from reprocessing to be conditioned in glass matrix.

- RFS III.2.c (5 April 1984): Particular safety measures for production, control, treatment, conditioning and interim storage of low or intermediate level waste from reprocessing to be conditioned in bitumen matrix.

- RFS III.2.d (1 February 1985): Particular safety measures for production, control, treatment, conditioning and interim storage of waste from reprocessing to be conditioned in concrete matrix.

- RFS III.2.e (31 October 1986 revised 29 May 1995): Conditions prior to acceptance of solid waste in surface disposals.

- RFS III.2.f (10 June 1991): Definitions of safety objectives for disposal of radioactive waste in deep geological formations in the post-closure phase.

2.3.2 Decommissioning / dismantling

The ASN's note SD3-DEM-01 of 17 February 2003 considers two main periods in a facility lifetime, each being suject to licensing:

- the operational period,

- the decommissioning period.

In regulatory terms, decommissioning of nuclear facilities requires several major phases:

phases under the licensing of operation of the facility (decree of creation of the BNI):

- the decision to stop the normal operation of the facility. An information by the licensee is due, including a previsional schedule,

- the final cessation of operation leading to the end of operation according to normal operating procedures. This phase includes the removal of all the fuel, removal of the waste produced during the operation phase and still present on site, treatement of fluids, clean-up and evacuation of hazardous material. The operator must inform the ASN, six months prior starting these operations, and submit a safety case. The ASN formally acknowledges the end of this phase on the basis of a completion report and after a thorough visit,

phases under a new authorization decree (decree for final shutdown and decommissioning):

- the phase leading to the shutdown status of the facility. This phase, which can be started while the previous one is still going on, consists in dismantling the pieces of equipment which are no longer required for surveillance and safety. The containment is reinforced. At the end of this phase, a complete inventory of the radioactivity is conducted,

- the final shutdown which could include preparatory operations for decommissioning that cannot be done under normal operating rules. This phase includes additional clean-up and elimination of pieces of equipment, using new operation rules, different from normal operation, that allow to decrease progressively the necessary monitoring of the facility and of its surroundings,

- the decommissioning/dismantling of the facility with the objective to reach an end-state enabling license termination,

- license termination, ideally unconditional site liberation. This termination leads to change of the facility's administrative status and often to restrictions of use. Compliance is checked on the basis of a completion report and a thorough visit of the ASN.

This note lists the documents to be provided by the operator in view of the authorization for final shutdown and decommissioning/dismantling of its installation (decree):

- a document justifying the selected configuration in which the installation will be left after final shutdown and indicating the various stages of subsequent dismantling (including the definition of the end point of decommissioning),

- a safety analysis report,
- the general surveillance and servicing rules to ensure that a satisfactory level of safety is maintained,
- an updated on-site emergency plan for the installation concerned,
- an environmental impact analysis pertaining to the proposed operations,
- a study covering the waste management strategy of the operator.

A public inquiry takes place if the nature and risk of the dismantling operations justify it. It is systematic for the decommissioning of nuclear reactors.

The ASN's note SD3-DEM-02 of 27 March 2006 set recommandations for methodologies of complete clean-up of contaminated or activated structures (notably concrete structures) in BNIs.

The ASN's note SD3-EDF-01 of February 2004 describes procedures relative to authorizations during the dismantling operations of NPP installations (EDF) and the corresponding documentation. This includes EDF internal authorizations.

The ASN's note SD3-CEA-01 sets requirements concerning internal authorization procedures inside CEA organization.

3. STATUS, STRATEGIES AND CURRENT ISSUES AT THE NATIONAL LEVEL

3.1 Status

3.1.1 Waste classification and quantities

The various types of radioactive waste produced in France vary considerably by their activity levels, their half-lives, their volumes and their contents (fission products, scrap metal, rubble, sludges, resins, etc.). The treatment and final disposal solution must be adapted to the type of waste involved, in order to manage it safely.

The radiological risk can be assessed on the basis of two main parameters: the activity level and the half-life.

The classification makes the distinction between very short lived waste, short lived waste and long lived waste, and on the other hand on the distinction between very low, low, intermediate or high level waste. It is based on the existing or expected management pathways (see 3.2.1).

Table 1. **Existing or future disposal systems for the main solid waste and residues resulting from radioactive effluent treatment**

Activity/period	**Very short lived**	**Short lived**	**Long lived**
Very low level	Management by radioactive decay	Surface disposal facility (Morvilliers) (*). Recycling channels (under investigation)	
Low level		Surface disposal at the Aube repository Tritiated waste: under study (see Law 2006-739 of 28 June 2006)	Dedicated subsurface disposal facilities designed for waste containing radium and graphite under study (see Law 2006-739 of 28 June 2006)
Intermediate level			Waste management solutions under study in the framework of Law 2006-739 of 28 June 2006
High level		Waste management solutions under study in the framework of Law 2006-739 of 28 June 2006	

(*) Waste residue from uranium ore processing has its own specific disposal facilities provided for in the vicinity of the production sites.

Very short lived waste:

Medical use of radioactivity for diagnosis or therapy implies the utilisation of very short lived radionuclides. They are managed by radioactive decay on the production sites. The resulting waste is then considered as conventional and managed in the same way as other conventional waste.

Very low level waste:

Very large quantities of very low level waste were produced in the past during operation of the French uranium mines. This category of waste contains a very small quantity of long lived radionuclides, notably radium. Since moving the millions of tonnes concerned is obviously out of the question, it is planned to appraise the long-term impact of the sites (considered as disposal sites) and determine actions from this appraisal if any.

Today's very low level waste comes mainly from the dismantling of nuclear facilities or conventional industrial sites using slightly radioactive substances. The quantity involved will increase considerably when the time comes for the large scale complete dismantling of nuclear power reactors currently in operation. Radioactivity in these cases amounts to a few becquerels per gram.

Long lived low level waste:

Long lived low level waste includes the particular category of waste containing a significant quantity of radium and producing radon. This type of waste was notably produced in the past by the rare-earth industry. Long lived low level waste also includes graphite waste originating from gas-cooled reactors that have been since shut down. The activity of graphite waste is mainly of the beta-gamma type.

Short lived low and intermediate level waste:

The activity of short lived low and intermediate level waste is mainly due to beta or gamma radiation emitting radionuclides, with a half-life of less than 30 years. Alpha particle emitters are strictly limited. This type of waste comes from nuclear reactors, fuel cycle facilities, research centres as well as university and hospital laboratories. They consist mainly of manufacturing waste, worn equipment, materials cleaning rags and protective clothing. This category also includes products from gaseous and liquid waste treatment at nuclear installations.

High level waste and long lived intermediate level waste:

These types of waste contain radionuclides with a long half-life, notably alpha emitters. They comprise both intermediate level and high level waste. The former mainly comes from spent fuel structures (cladding hulls and end caps) and maintenance operations. Within this category of waste, the alpha emitters can be found in significant quantities. The second category generally originates from fission and activation products contained in spent fuel and separated from recoverable materials by the reprocessing operations. Their activity is such that the heat release for each 150 liters container can reach 2.5 kW (at the date of fabrication). These high-activity types of waste could also include CEA fuel, irradiated in research reactors, and EDF spent fuel which would not be reprocessed, should the case arise.

The table below presents, for each category of radioactive waste currently produced, an estimation of the annual throughput and the total activity and volume foreseen in 2020. These data constitute simply an indication and can vary depending on the treatment options selected and the spent fuel management strategy adopted. However, they clearly show that the largest volumes concern very low level or short lived low and intermediate level waste, representing only a minute fraction of the total activity. The high level waste, representing a very small volume, comprises more than 96% of the total activity.

Further information on the state and localisation of radioactive waste on French territory, including military installations, can be obtained from the National inventory of radioactive waste and recoverable material, edited in 2006.

Table 2. **Annual quantities of waste produced and total quantity expected by 2020 (sources: ANDRA National Inventory pubished in 2006). *Postulates*: 58 PWR operating power reactors, 20 of which use MOX fuel; 850 t of irradiated fuel reprocessed per year**

Note: This excludes waste from the reprocessing of foreign irradiated fuel which, in compliance with the French legislation, is returned to the owners after an interim storage period.

Type of waste	**Estimated annual throughput (m^3) 2005 - 2020**	**Volumes foreseen for 2020 (m^3)**	**Corresponding total activity in 2020 (*TBq*)**	
			Alpha	**Beta/gamma**
Very low level (VLLW)	15,000 to 40,000 (depending on the year)	580,000 (VLL repository at Morvilliers)	9	
Short lived low and intermediate level (LILW-SL)	15,000 to 28,000 (depending of the year)	670,000 (Aube repository)	1200	30,000
Long lived low level (LLW-LL)		105,000	50	9000
Long lived intermediate level (ILW-LL)	600	55,000	27,000	3,800,000
High level (vitrified) (HLW)	100	3600	3,9000,000	125,000,000

Note: the volumes of radioactive waste coming from dismantling operations (all existing nuclear installations) after 2020 are estimated at 10,000 m3 ILW-LL; 9000 m3 LLW-LL; 355,000 m3 LILW-SL; 565,000 VLLW.

3.1.2 Installations in a decommissioning phase

The majority of decommissioning activities in France is occuring in two sectors : the civilian nuclear facilities and the deterrent nuclear facilities.

In France there are three major operators concerned with decommissioning activities : EDF (Electricité de France), AREVA/Cogema, and CEA (Commissariat à l'Energie Atomique). ANDRA is in charge of disposal of radioactive wastes, including those originating from dismantling operations (existing repositories and research/studies for new repositories).

The main installations which are at a dismantling stage are the following :

- all gas-cooled reactors (Bugey 1, Chinon A1D, A2D, A3D, Saint-Laurent-des-Eaux A1 and A2), one pressurized water reactor (Chooz AD), one fast neutron reactor (Superphenix), one heavy water reactor prototype moderated with carbon dioxide cooling (EL4/Brennilis), i.e. 9 reactors all together,

- several nuclear installations of the CEA civilian research centers,
- various installations linked to the deterrent force: Marcoule reprocessing plant, reactors located at Marcoule, “low, intermediate, high and very high plants” at Pierrelatte.

In the past, the generic strategy chosen by EDF was that of immediate level 2 dismantling of its stopped power reactors, the complete dismantling (referred to as level 3) being envisaged after several decades of containment.

After an initial evaluation submitted to the ASN in November 1999, EDF decided to revise its strategy for the Brennilis reactor, by undertaking to finish dismantling of the reactor rapidly, after completion of the partial dismantling currently in progress.

In January 2001, EDF chose to adopt a new dismantling strategy for all its nuclear facilities which have been finally shut down (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix), based on level 3 dismantling of the reactors in advance without the waiting period. This new strategy provides for complete dismantling of the reactors by the year 2025. In March 2004, the Advisory Committee examined the strategy and concluded that there was no technical hindrance to the programme.

3.2 National strategies

3.2.1 Waste management

For the ASN, the management strategy must cover all categories of radioactive waste. This involves setting up specific waste management systems, taking into account not only radiological risks, but also chemical and sometimes biological hazards incurred by that waste.

Waste management begins with the nuclear plant design, proceeds during the operating life of the installation through concern for limitation of the volume of waste produced, of its noxiousness and of the quantity of residual radioactive materials contained. It ends with waste elimination (recycling or final disposal) via the intervening stages of identification, sorting, treatment, packaging, transport and interim storage. All operations associated with management of a category of waste, from production to disposal, constitute a waste management route, each of which must be adapted to the type of waste concerned.

The operations within each route are interlinked and all the routes are interdependent. These operations and routes form a system which has to be optimised in the context of an overall approach to radioactive waste management encompassing safety, traceability and volume reduction issues.

It is to be noted that long-term management solutions exist in France (repositories) for the categories of radioactive waste which represents the major volumes (but with a low radioactive content): the short lived low and intermediate level waste (LIL-SL waste) and the very low level waste (VLL waste). The existing solutions are briefly described as follows:

- *Very low level waste repository:*

The very low level waste repository (Morvilliers in the Aube department) has been in operation since August 2003. Its overall capacity is 650,000 m3. At the end of 2005, the volume of waste disposed of was about 41,500 m3.

Waste is disposed of in special cells excavated in a clay formation and protected by a synthetic membrane and, in the future, by a clay cover.

This disposal facility is operated by ANDRA.

- Short lived low and intermediate level waste repository:

The technical solution adopted for the long-term management of this type of waste is disposal in a surface repository where adequate waste packages are placed in concrete structures.

In the past, this type of waste was disposed of at the Manche repository operated by ANDRA (527,000 m3). Waste reception has stopped in 1994 and this disposal facility has now entered a surveillance phase (decree of 10 January 2003).

Surveillance is under the responsibility of ANDRA. The technical requirements associated with the decree concern notably the monitoring of the protective cover, the maintenance of the facility and the long-term preservation of information. The conditions of the surveillance phase will be reassessed 8 years after the aforesaid decree.

Short lived low and intermediate level waste has been disposed of since 1992 at the Aube repository also operated by ANDRA. Since the beginning of its operation the Aube repository has disposed of about 175,000 m3 of waste (end of 2005) . In 2004, the first vessel head packages originating from nuclear power plants reactors were disposed of at the Aube repository, and 9 vessel head packages were disposed of in 2005.

The overall capacity of the Aube repository is 1,000,000 m3. Its lifetime is planned for 30 years but could be extended to about 50 years as the quantity of waste yearly received has decreased in the last years.

The definitive operating license was granted on 2 September 1999.

In 1995, ASN defined, in the basic safety rule RFS III.2.e, revised requirements for radioactive waste package acceptance for disposal in a surface repository. The respective responsibilities of ANDRA and the waste producers are stated in the rule. ASN carries out inspections to check that the acceptance procedures comply with the requirements of RFS III.2.e and are correctly implemented.

Concerning the minimization of waste volumes, CENTRACO receives short lived low and intermediate level waste either for incineration or, in case of metal scrap, for melting.

With regard to the other categories of radioactive waste the strategy is defined in the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006). This law is a consequence of the law n° 91-1381 of 30 December 1991 which stipulated that, in 2006 at the latest, the government shall submit to Parliament an overall assessment of the research concerning high level, long lived waste, with a draft law authorizing, if appropriate, the creation of a disposal facility for these categories of radioactive waste. At the same time, the law of 28 June 2006 widens the field of action initially aimed at by the law of 30 December 1991.

This law of 28 June 2006 stipulates that for high level waste and long lived intermediate level waste the research and studies have to be pursued according to three complementary strands (see § 3.3.1 for more details):

- separation and transmutation of long-lived elements, so that an assessment can be made in 2012 of the industrial prospects of reactors allowing transmutation and a prototype installation set in operation before 31 December 2020;
- reversible disposal in deep geological formations, in order that an application for its authorization can be made in 2015, and, subject to such an authorization, the centre can be set in operation in 2025;
- storage, in order, at least in 2015, to create new storage installations or modify existing ones to meet the needs.

This law defines the programme for the other types of radioactive waste which do not have a final solution (graphite waste and radium-containing waste, tritium-containing waste, sealed sources) and for the long-term impact of the disposal sites of uranium mining wastes and implementation of a strengthened radiological surveillance plan at these sites.

It stipulates that a National plan for the management of radioactive materials and wastes shall be drawn up before 31 December 2006 and, afterwards, shall be updated every three years.

There are also articles concerning various topics (no disposal in France of radioactive waste from abroad, rules concerning the introduction in France of spent fuel, a national commission tasked with evaluating, annually, the progress of research and studies with reference to the above-mentionned National plan).

It is to be noted that this law relies on the following process which has been followed since 1991:

- selection of sites for further investigations for underground laboratory (by a mediation mission),
- geological investigations from the surface at four sites (by ANDRA),
- application for construction of underground laboratories and public inquiries,
- governmental authorization for one laboratory in the East of France, in a clay formation,
- new attempt for a candidate site in a granitic formation, unsuccessfully, and decision to continue on generic studies on granite,
- construction of the underground laboratory in the East of France (by ANDRA),
- research concerning a reversible repository (notably by means of the underground laboratory) and studies (design of repository, knowledge of waste packages and engineered barriers behaviour, safety analysis,..), having led to the “rapport argile 2005” and a generic report on feasibility of a geological repository in granitic formation “rapport granite 2005” (by ANDRA),
- research concerning partitioning and transmutation, including reports (by CEA),
- research concerning long term storage, including reports (by CEA),
- annual assessment by the National Review Board, and final report at the begining of 2006,
- periodic review by the ASN and its technical supports, and advice to the government at the begining of 2006,

- report, in March 2005, of the Parliamentary Office for Evaluation of Scientific and Technical Options,
- a public debate organized by the "Commission Nationael du Débat Public" (CNDP) from September 2005 to the end of December 2005 (and a report at the begining of 2006),
- A draft version in 2005 of a National Plan for the management of radioactive waste and recoverable material, launched by the ministry in charge of environment, and led by the ASN.

3.2.2 Decommissioning / dismantling

As above-mentioned in § 1.1.1, the dismantling scenario (immediate or deferred) is selected by the operator on a case by case basis, generally in the light of comparative studies.

Similarly, the various provisions chosen for each stage in dismantling of a nuclear installation are chosen by the operator. The operator is asked to justify that the strategy proposed is the best one in terms of safety, radiation protection, and final status of the installation.

Although the regulations do not stipulate dismantling as soon as reasonably feasible, the ASN is in favour of immediate dismantling for various reasons such as loss of familiarity with the design and operation of the installation, the minimal advantage gained from radioactive decay, or the risk of equipment obsolescence. At present all operators in charge of a current dismantling operation apply this policy. Besides the ASN asked EDF to make a study aiming at defining the future strategy for dismantling of NPPs which are still in operation, taking account of the number of NPPs, their standardization, and dates of shutdown.

From a regulatory point of view, to avoid splitting up the dismantling projects and to improve overall consistency, the ASN asks that as of final shutdown of an installation, a file be submitted, explicitly presenting the various steps of works envisaged from final shutdown to attainment of the target final state, and demonstrating at each step the nature and scale of the risk presented by the installation and the steps taken to control it (see § 3.3.2).

The ASN considers that the current dismantling operations should be exemplary. They are an opportunity for the operators to define and implement a dismantling strategy on the one hand (level of dismantling to be attained, schedule of operations) and a management policy for the large quantity of radioactive waste generated (in particular very low level waste), on the other. If seen through to completion, they should also be demonstrations of the technical and financial feasibility of complete dismantling.

3.3 Issues at national level

3.3.1 Waste management

- *Long lived low level waste:*

Generic studies have been performed by ANDRA. At this stage a site needs to be selected in order to initiate detailed studies.

According to the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006), the disposal centre should be set in operation in 2013.

In the meantime, the situation of the existing storage facilities, in term of safety, is under consideration.

- Short lived low and intermediate level waste

Regarding the Manche repository, now in the surveillance phase, ASN asked ANDRA to begin to look at the future of the covering layer. This should be the subject of a report into the the benefits to be gained from installing a new and more durable cover, no longer than 2009.

Short lived intermediate and low level waste includes certain categories which have characteristics making them unsuitable for acceptance at the Aube repository. These cover tritiated waste, mainly originating from Defence activities, and stored at Valduc. Tritium is difficult to confine. It appears that this type of waste, even conditionned in specifically designed containers, cannot be disposed of at the Aube repository. Solution to manage this type of waste is still under study. The 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006) requires development by 2008 of storage allowing a reduction of their radioactivity before disposal at the surface or at a low depth.

- High level waste and long lived intermediate level waste

As above-mentioned (§ 3.2.1), the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006) stipulates that the research and studies on these wastes shall be pursued according to the three following complementary strands:

- Separation and transmutation of long-lived radioactive elements. The corresponding studies and research shall be conducted in relation with those performed on the new generations of nuclear reactors mentioned in Article 5 of the Programme Act n° 2005-781 of 13 July 2005 fixing the guidelines of the energy policy and those performed on accelerator-driven reactors devoted to waste transmutation, so that an assessment can be made in 2012 of the industrial prospects of these reactor types and a prototype installation set in operation before 31 December 2020,

- Reversible disposal in deep geological formations. The corresponding studies and research shall be performed in order to choose a site and design a disposal centre so that, on the basis of the results of the studies undertaken, an application for its authorization can be made in 2015 pursuant to Article L542-10-1 of the Environmental Code and, subject to said authorization, the centre can be set in operation in 2025,

- Storage. The corresponding studies and research shall be performed in order, at the latest in 2015, to create new storage installations or modify existing ones to meet the needs, in particular in terms of capacity and lifespan.

- *Other issues*

According to the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006):

- Processes allowing the disposal of spent sealed sources at existing or to-be-built centres shall be finalized by 2008,

- Short and long term management solutions for wastes with enhanced natural radioactivity, proposing new solutions, if applicable, shall be appraised in 2009,

- The long term impact of the disposal sites of uranium mining wastes and implementation of a strengthened radiological surveillance plan at these sites shall be appraised in 2008.

Solutions for the *management of legacy waste* are also a challenge for several reasons:

- ASN has to make sure that temporary solutions do not become definitive as a result of lack of action. In this respect, the CEA and AREVA/Cogema have started a clean-up of their installations where legacy waste is temporarily stored,

- Legacy wastes often need to be characterized more precisely and conditionning processes need to be adapted to their specificity. This often needs a step-by-step approach and takes a long time,

- Therefore, safety of the storage facilities has to be periodically reassessed and sometimes measures aiming at improving safety of the storage have to considered and implemented,

- Dismantling of an old installation is often dependent on removal of legacy waste stored in it. This can lead to delay deconstruction of equipment and structures, which may be a safety issue in itself.

3.3.2 Decommissioning/dismantling

Current issues are linked to the risks due to the dismantling operations themselves and the waste management. Those risks require a lot of attention.

Indeed the rapidly changing nature of the installation is a non-negligible risk factor in that it is harder than for an operating installation to guarantee that all potential risks have been consistently and exhaustively taken into account.

The first steps lead to removal of the fuel or nuclear materials present in the installation, which already helps reduce the risk from the nuclear safety viewpoint. This is then replaced by risks linked to radiation protection of persons and conventional safety owing to operations close to residual nuclear material and the numerous waste removal handling operations generated by dismantling.

As dismantling proceeds, the risks identified during operation of the installation, primarily linked to the radioactive nature of the materials handled, are gradually replaced by risks more linked to radiation protection and conventional safety (dismantling requires that the workers go into areas they were not used to visiting during operation) or risks linked to the technologies used for dismantling and cutting the structures (often involving hot points with the concurrent risk of fire or explosion). The risks linked to the problem of the stability of partially dismantled structures must also be taken into account, along with those linked to the obsolescence of the equipment (in particular concerning the possibility of fires breaking out in ageing electrical installations).

For complex nuclear installations, dismantling work often lasts more than a decade, frequently coming after several decades of operation. There is thus a considerable risk linked to loss of familiarity with the design and operation of the installation, especially when the former operators leave the installation, and it is vital to be able to collect and record the recollections of the persons involved in these phases, all the more so as the traceability of the design and operation of old installations is frequently less than rigorous.

With each subsequent phase in dismantling, arises the question of the surveillance of the installation being at all times appropriate to its state and the risks entailed. It is often necessary to replace the in-service means of surveillance with other (radiological, fire) more appropriate means, either temporarily or more permanently. As it is hard to constantly check that surveillance is appropriate to the constantly changing state of the installation, there is a risk of failure to detect an incipient hazardous situation.

Once the final installation state is reached, there is still the risk of pollution being inadequately or not at all identified or poorly characterised, having a significant long-term impact on the site or its environment. From an administrative point of view, it seems necessary, in most cases, that there be a means of preserving the memory of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions corresponding to the condition of the site.

In regard of those issues and problems, the following arrangements have been made:

- as above-mentionned (§ 2.3.2), ASN's note SD3-DEM-01 (17 February 2003) describes the general principles and regulatory procedures concerning decommissioning/dismantling of BNIs,

- the problem of authorizations has been clarified:

  . firstly, when dismantling an installation is expected to last many years, or even several decades, the main stages are defined in the decree which authorizes the shutdown and dismantling of the installation. As well as defining the main stages, the file submitted by the operator for the decree details the works which will be carried out in the next few years (typically five years after the decree authorizing the dismantling of the installation). Therefore the decree is detailed with regard to this period. For the subsequent phases of works, the decree mentions the main obligations, and states that specific authorizations are needed before starting the next stages and certain works deemed as crucial: authorizations are given on the basis of detailed files to be provided by the operator and accepted by the ASN after review,

. secondly, besides the authorizations to proceed from one stage to the other (given by the ASN, see above), authorizations for works are necessary during each stage. Because of the continuous evolution of the installation, adapted procedures are necessary. For exemple, the ASN's note SD3-EDF-01 (2004) defines the types of authorizations which can be given by EDF and the corresponding practical details. Indeed the ASN authorized EDF to put in place a system of internal authorizations for dismantling operations of its installations. Such internal authorizations are limited to evolutions which do not impair the safety demonstration. They must be scheduled (schedule transmitted to the ASN), assessed by an entity different from the operator of dismantling, and declared to the ASN. EDF has to maintain the set of analysis and documents updated and the ASN conducts inspections a posteriori. This system of internal authorizations improves the process: it provides flexibility, gives an increased sense of responsibility to the company, and gives the ASN more time to deal with the most important safety issues.

- The need became apparent for conservation of a trace of the past existence of a BNI on a site, along with any utilisation restrictions appropriate to the condition of the site. A conventional constraint on behalf of the State is established by the ASN, together with the local State representatives concerned, and proposed to the owner of the land. This constraint is recorded in the mortgage register to guarantee its permanence.

The risks linked to waste management (radioactive waste disposed of inappropriately in a conventional channel, etc.) are present throughout all dismantling phases. Waste management relies on the concept of zoning as explains in paragraph 2.1 (Ministerial order of 31 December 1999). Dismantling produces large quantities and a wide variety of radioactive waste. However the radioactive waste produced (or expected to be produced) by existing and future dismantling activities is mainly very low level waste or short lived low and intermediate level waste.

The nuclear waste generated (i.e. coming from a nuclear zone) has the same disposal routes as the waste originating from BNI in operation:

- the existing very low level waste repository,

- the existing Centre de l'Aube repository (short lived low-and intermediate level waste).

For graphite waste (long lived low level waste) and long lived intermediate level waste, produced in operation or during dismantling phases, long term management solution is under study (see paragraphs 3.3.1).

4. CURRENT ISSUES AND PRIORITIES FOR THE REGULATOR

4.1 Waste Management

4.1.1 Issues and priorities

ASN has three priorities:

- Safety at each stage in radioactive waste management: production, treatment, packaging, interim storage and disposal.

- Safety of the overall radioactive waste management strategy, ensuring overall consistency.

- The setting up of waste management solutions well adapted to each categories of waste. Any delay in identifying waste disposal solutions increases the volume and size of the on site interim storage facilities.

A national plan for the management of radioactive waste and recoverable material (PNGDR-MV) was launched by the Ministry in charge of environment in June 2003. It has been led by the ASN up to now. A draft version of the plan has been made available to the public (ASN's website) for information and comments.

As above-mentioned (§ 3.2.1), the 2006 programme act on the sustainable management of radioactive materials and wastes (law 2006-739 of 28 June 2006) stipulates that a National Plan shall be established for the first time by the end of 2006 and updated every three years by the Government and transmitted to Parliament.

The PNGDR-MV aims at achieving an overall, coherent, safe and transparent waste management policy. Radioactive waste of all origins is considered: radioactive waste from the nuclear industry but also radioactive waste from medical activities, research, conventional industry and past activities (polluted sites from radium industry). It is based on the National inventory of radioactive waste and recoverable material established by ANDRA. The main objectives of this plan which takes into account the priorities of ASN are the following:

- clear definition of the waste to be considered as radioactive, taking account of the existence of natural radioactivity of variable levels and of certain radioactive materials for which reuse has not been envisaged;

- setting up of management solutions for each categories of waste;

- consideration of legacy waste;

- consideration of public concerns;

- consistency of the entire radioactive waste management structure, whatever the level of radioactivity or chemical or infectious toxicity, in particular for waste with a "mixed" risk;

- optimisation of waste management by the producers;

- consistency of practices to deal with polluted sites and reclamation methods.

The following actors were invited to take part in the work on the PNGDR-MV : representatives of the waste producers, the disposal facilities, ANDRA (the National Agency for Radioactive Waste Management), environmental protection associations, elected representatives and the directorates of the ministries concerned.

It is worth noting that, in the previous years, emphasis has been placed on regulation of radioactive waste produced in nuclear installations. The regulation on radioactive waste coming from conventional industry and hospitals is now under development.

4.1.2 Development in policy and regulation

For short lived low and intermediate level waste (LILW-SL) the main concern is the regulation concerning the institutional control period for disposals and the definition of the different phases of this control period.

Concerning acceptance criteria of LILW-SL packages, the Basic Safety Rule RFS-III.2.e is in the process of being revised.

Concerning deep disposal of high level waste and long lived intermediate level waste, the Basic Safety Rule RFS III.2.f was published by the Nuclear Safety Authority in June 1991. It sets out the radiation protection objectives to be met for geological disposal, basic principles for repository design linked to safety, site selection criteria and guidance for elaborating the safety case. The revision of this Basic Safety Rule is in progress taking into account the new ICRP 81, experience feedback at the national and international level and the possible incorporation of a retrievability period.

A Belgian-French collaboration involving regulators and implementers was set up in 2000 to develop the reflection on the safety approach related to geological disposal of radioactive waste. It led to the publication, in September 2004, of a common reflection document entitled: “Elements of a Safety Approach for Geological Disposal of Radioactive Waste”. Starting from this, European seminars involving regulators from eight countries and three international organizations (IAEA, NEA and EU) set up the basis for developing a pilot study on the regulatory review of a safety case for geological disposal involving national regulators and international organizations cited above.

Waste packages for deep disposal are currently being produced by main high level waste and long lived intermediate level waste producers: EDF, COGEMA and CEA. ANDRA has chosen a step-by-step procedure with regard to the future acceptance of waste packages. At the beginning, the only specifications were those related to knowledge. Following requests from the French Nuclear Safety Authority, ANDRA has established further specifications, and especially the so-called level 2 specifications which identify and quantify characteristics of HLW and ILW-LL packages taken into account in ANDRA’s research and studies, including:

- justification of each characteristic vis a vis ANDRA’s works,

- flexibility regarding each characteristic of waste packages.

An acceptance procedure has been put in place by ANDRA, by type ("family") of waste packages. An "accepted" type of waste packages means that the charactic of this type of waste packages is taken into account in ANDRA's deep disposal project. "Acceptance" is based mainly on the radiological and physico-chemical characterisation of the waste packages which are being produced and the quality management for their fabrication. ANDRA performs controls on sites to assess the quality of fabrication.

Since 1998, the setting up of this procedure has been closely followed by the ASN, in particular through inspections.

Concerning the storage of radioactive waste, the work done by WENRA (Western European Nuclear Regulators' Association), set up to develop a common approach to nuclear safety and regulations within the Union, should lead to a reinforcement of the body of the French regulatory texts. The ASN plays an active role in WENRA.

4.2 Decommissioning/dismantling

4.2.1 Issues and priorities

Issues and priorities are linked to the large programme of decommissioning in France.

The operators and the ASN shall make good use of the feedback and experience gained during the current dismantling operations, in order to improve the system put in place, if need be.

The findings of WENRA in the field of decommissioning shall also be taken into consideration (see § 4.2.2 below).

4.2.2 Developments in policy and regulation

The work done by WENRA (Western European Nuclear Regulators' Association), set up to develop a common approach to nuclear safety and regulations within the Union, should lead to a reinforcement of the body of the French regulatory and guidance texts. The ASN plays an active role in WENRA.

5. RESEARCH AND DEVELOPMENT PROGRAMME BY THE REGULATOR FOR BOTH WASTE MANAGEMENT AND DECOMMISSIONING

5.1 Functions

Concerning radioactive waste management an extensive research and development programme is conducted by ANDRA and the CEA. It is not described here.

R&D programme concerning the safety analysis of nuclear waste disposals is developed by IRSN (technical support of the ASN). It relates to the safety approach (safety strategy, site characterisation, repository concepts, performance assessment) and the scientific and technical bases for safety assessment, construction and operation of a repository.

Dismantling research and development programmes essentially apply to technology (measurements, modelling, simulators, decontamination, tools…). They are for the needs of operators.

5.2 Contents of research and development plans

5.2.1 Waste Management

In general research and development works developed by IRSN consist in developing independent modelling capabilities for safety assessment and testing different general safety assessment methodologies by participating to international exercises, essentially in the field of geological disposal. They aim at developping the IRSN expertise in judging the applicant approach.

In 2005, IRSN continued to develop models aiming at assessing the behaviour of a geological repository (confinement capacity of a clay formation, excavated damaged zone,...).

IRSN also developped the “Melodie” software for modelling the transfer in geological formations. This computer code was used to assess the “2005 dossier argile” issued by ANDRA.

Experimental work is performed by IRSN in independent geological formations such as a clay layer in the Tournemire tunnel in Central France. The research programme, carried out from a tunnel inside the geological formation itself, consists of detailed studies on fluid transfers characterisation through argillaceous formation and impact of perturbations (mechanical, hydro-mechanical, geochemical,...) on clay-rock behaviour. In particular it aims at describing the thermal, hydraulic, mechanical and chemical behaviour of a radioactive waste repository site, taking account the disturbances caused by the implementation and the progressive deterioration of the various constituent materials. Under the Decovalex international project, IRSN started an exercice in modelling of the excavation disturbed zone around the Tournemire tunnel. In the Mont Terri tunnel in Switzerland an experiment of diffusion is in progress.

In addition, IRSN carried out studies, in collaboration with Universities and Schools, such as the hydraulic modelling of the Paris basin (especially the Bure site) , the development of a water transport program including the possibility of change of phase (liquid/gas), and the development of a modelling approach for repository structures in a geological environment to identify the complementarity of barriers.

Some of the studies are part of the 6th PCRD.

5.2.2 Decommissioning

As above-mentioned dismantling research and development programmes essentially apply to technology (measurements, modelling, simulators, decontamination, tools…), for the needs of operators.

5. FINANCING OF RADIOACTIVE WASTE MANAGEMENT AND DECOMMISSIONING

In France, operators are responsible for financing the management of their waste and the decommissioning of their nuclear installations.

It is important that financial ressource (funds) will be sufficient and available when needed, notably to ensure a satisfactory safety level of the future operations.

Several reports were published in France in 2005 on this subject. Several actions were also launched by the European Union (Commission, Council, Parliament) and the French administration participates in them.

In January 2005, the French Court of Accounts issued a specific report entitled “the decommissioning of nuclear installations and management of radioactive waste”. This report acknowledges the progress made for several years in the field of financing but includes a number of recommendations to improve the existing situation. The annual report (2006) of the Court contains a follow-up of its 2005 specific report.

A working group was set up by the ministry of industry to review the cost of a geological disposal. This working group determined a range of costs, depending on various hypotheses, in the first semester of 2005.

The total amount of future expenses (liabilities) for decommissioning and radioactive waste management, for the three major nuclear operators (EDF, AREVA, CEA), has been estimated by them at about 65 billions Euros (2004 value, i.e. undiscounted) corresponding to a discounted value of about 37 billions Euros (3% discounted rate).

Each nuclear operator (EDF, AREVA, CEA) manages its fund which stays inside the company. However, the situation differs from one company to the other. AREVA has already earmarked assets corresponding to the total anticipated expenses estimated by this operator. Answering a remark of French Court of Accounts, EDF decided in September 2005 to accelerate the rhythm of assets collection in the next years in order to reach, in 2010, the necessary level of provisions estimated by EDF. CEA manages two funds (one for its civilian centers and the other for centers linked to the deterrent force) which will need to be developped in the future.

The ASN pointed out the following principles in its annual report published in early 2006:

- identification of all liabilities which are relevant, regarding the necessary financial provisions,
- the bases for liabilities estimate (scenarios, hypotheses, methods including uncertainties, international comparisons…),
- discounted rate(s),
- nature of the funds, identification (earmarking), mechanism securing the funds (wise management of the funds, use for what the funds have been created, protection against creditors…),
- rythm of assets collection,
- future withdrawals of sums to cover expenses,
- information / transparency.

At the time the ASN stated that a framework (law, decrees, guides) is necessary and a supervision system should be put in place.

Finally the 2006 Programme act on the sustainable management of radioactive materials and wastes (28 June 2008) stipulates the following, in its article 20:

- operators of BNIs shall assess prudently the costs of dismantling their installations and management of their spent fuels and radioactive waste,

- operators of BNIs shall establish reserves to cover the above-mentioned costs and earmark the necessary assets for the exclusive coverage of these costs. They shall account separately for these assets which shall present a sufficient degree of security and liquidity to meet their purpose,

- except where the State wields its powers to get the operators to respect their obligations to dismantle their installations and manage their spent fuels and radioactive wastes, nobody can claim to have a right over the assets , even on the basis of the Commercial Code,

- operators shall transmit every three years to the administrative authority a report describing the assessment of the costs, the methods applied for the calculation of these costs and the choices adopted with regard to the composition and management of the assets earmarked to cover the reserves. The first report is required by mid 2007. It shall include a plan for constituting the assets. Every year operators shall transmit to the administrative authority a note updating this report and inform it without delay of any event likely to modify its content,

- if the administrative authority finds insufficiencies or adequacies, it can, after hearing the operator, the necessary measures for the operator to regularise his situation, and, if need be, the administrative authority can order, on pain of a penalty payment, the constitution of the necessary assets,

- a national financial evaluation commission is created to assess the fundings of the costs in dismantling BNIs and managing spent fuels and radioactive wastes. This commission will issue a report which will be made available to the public.

A decree in application of this law is being prepared.

The ASN considers that the law corresponds to the principles laid down in its annual report.

Following the example of certain countries, the ASN should participate in the supervision of the funding system. Naturally, the ASN has a vocation for being consulted for assessing perimeter of liabilities, scenarios and hypotheses, and even more generally for the various aspects of the methodology used by operators for cost estimates.

The ASN will also be led to give advice on the financial mecanisms intended to ensure the availability of the funds at the expected dates.

ACRONYMS AND ABBREVIATIONS

ANDRA: Agence Nationale de Gestion des Déchets Radioactifs (French Nationl Agency for Radioactive Waste Management)

ASN: Autorité de Sûreté Nucléaire (French Nuclear Safety Authority)

BNI: Basic Nuclear Installation (installations containing radioactive materials over a certain level of radioactivity. Exemples: NPP, reprocessing plant, civilian CEA center, etc)

SBNI: Secret Basic Nuclear Installation Defence

CEA: Commissariat à l'Energie Atomique (French Atomic Energy Agency)

COGEMA: Compagnie Générale des Matières Nucléaires (AREVA Group)

DGSNR: - Directeur Général de la Sûreté Nucléaire et de la Radioprotection (Director General for Nuclear Safety and Radiation Protection)
- Direction Générale de la Sûreté Nucléaire et de la Radioprotection (General Directorate for Nuclear Safety and Radiation Protection – ASN centralized structure)

DSNR: Division de la Sûreté Nucléaire et de la Radioprotection (Regional Department for Nuclear Safety and Radiation Protection – ASN decentralized structure)

DSND: Délégué à la Sûreté Nucléaire et à la Radioprotection pour les activités et installations intéressant la Défense (Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities – French Ministries for Defence and Industry)

EDF: Electricité de France (Electricity of France)

ICPE: Facilities Classified on Environmental Protection Grounds (quantity of radioactive materials below the threshold of a BNI)

IRSN: Institut de Radioprotection et de Sûreté Nucléaire **(**French Institute for Radiation Protection and Nuclear Safety)

NPP: Nuclear Power Plant

PNGDR-MV: Plan National de Gestion des Déchets Radioactifs et des Matières Valorisables (French National Plan for the management of Radioactive Materials and Wastes)

PWR: Pressurised Water Reactor

RFS: Règle Fondamentale de Sûreté (Basic Safety Rule)